

Practice Problems 4.20.12 CP Physics

A cyclist approaches the bottom of a gradual hill at a velocity of 16 m/s. The hill is 5.4 m high, and the cyclist estimates that she is going fast enough to coast up and over it without peddling. Ignoring air resistance and friction, find the velocity at which the cyclist crests the hill.

$$\frac{1}{2}v_i^2 + 0gh_i = \frac{1}{2}v_f^2 + 0gh_f$$

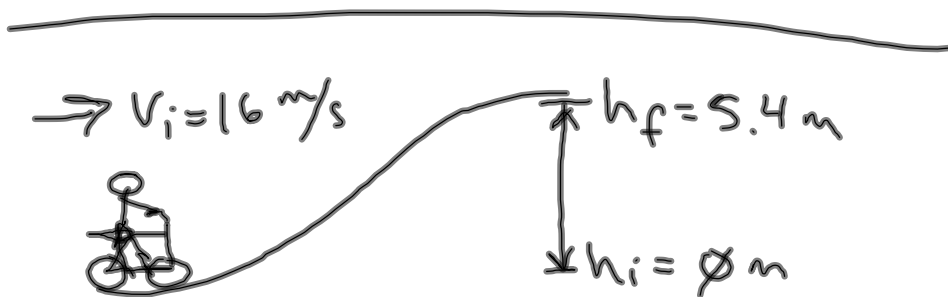
$v_i = 16 \text{ m/s}$
 $h_i = 0$
 $h_f = 5.4 \text{ m}$

$$128 = \frac{1}{2}v_f^2 + 52.92$$

$$75.08 = \frac{1}{2}v_f^2$$

$$12.25 \text{ m/s}$$

From:
Austin



$$E_i = E_f$$

$$K_i + U_{g_i} = K_f + U_{g_f}$$

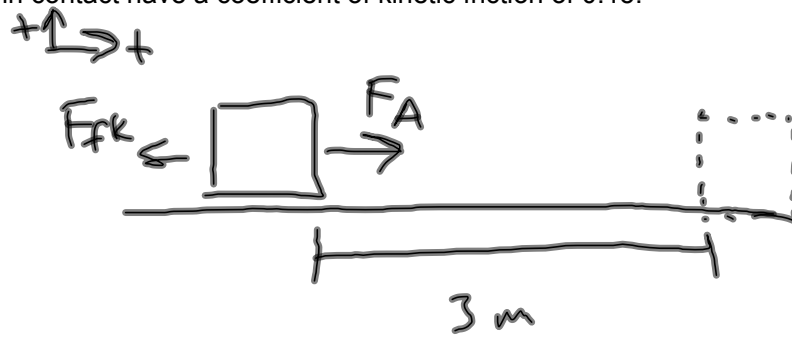
$$\frac{1}{2}v_i^2 = \frac{1}{2}v_f^2 + 0gh_f$$

$$v_f = \sqrt{v_i^2 - 2gh_f}$$

$$= 12.25 \text{ m/s}$$

Practice Problems 4.20.12 CP Physics

A 6.0 kg block initially at rest is pulled to the right along a horizontal surface by a constant horizontal force of 12 N. Find the speed of the block after it has moved 3.0 m if the surfaces in contact have a coefficient of kinetic friction of 0.15.



$$W = \Delta E$$

starts from rest
* no change in height

$$F_{\text{net}} d \cos \theta = (K_f - K_i) + (U_{gf} - U_{gi})$$

$$(F_A - F_{fk}) d \cos(0^\circ) = \frac{1}{2} m v_f^2$$

$$v_f = \sqrt{\frac{2}{m} [(F_A - F_{fk}) d]}$$

$$= \sqrt{\frac{2}{(6 \text{ kg})} [(12 \text{ N} - 8.82 \text{ N})(3 \text{ m})]}$$

$$= 1.78 \text{ m/s}$$

$$F_{fk} = \mu_k F_N$$

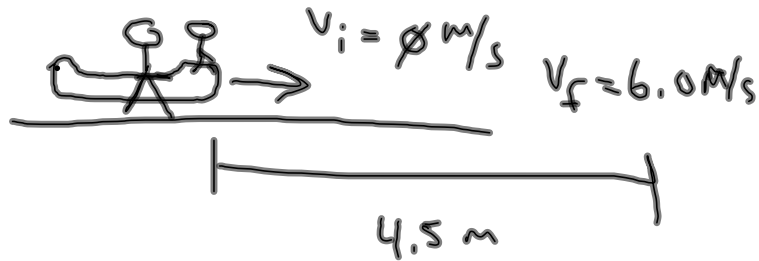
$$= \mu_k m a_g$$

$$= (0.15)(6 \text{ kg})(9.8 \text{ m/s}^2)$$

$$= 8.82 \text{ N}$$

Practice Problems 4.20.12 CP Physics

A 75 kg bobsled is pushed along a horizontal surface by two athletes. After the bobsled is pushed a distance of 4.5 m starting from rest, its speed is 6.0 m/s. Find the magnitude of the net force on the bobsled.



$$W = \Delta E$$

$$F_A d \cos \theta = (K_f - K_i) + (U_{Af} - U_{Ai})$$

$$F_A d = \frac{1}{2} m v_f^2$$

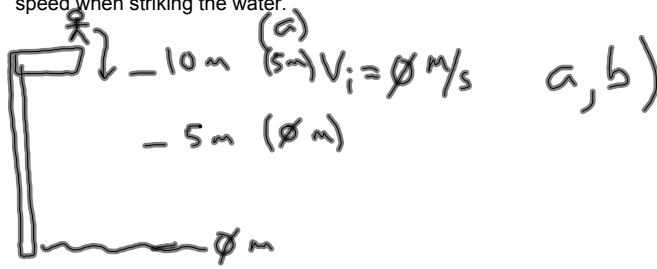
$$F_A = \frac{m v_f^2}{2d}$$

$$= \frac{(75 \text{ kg})(6 \text{ m/s})^2}{2(4.5 \text{ m})}$$

$$= 300 \text{ N}$$

Practice Problems 4.20.12 CP Physics

- a) A 755 N diver drops from a board 10 m above the water's surface. Find the diver's speed 5 m above the water's surface.
 b) Find the diver's speed just before striking the water.
 c) If the diver leaves the board with an initial upward speed of 2 m/s, find the diver's speed when striking the water.



$$a) \quad \frac{1}{2} v_i^2 + a_y h_i = \frac{1}{2} v_f^2 + a_y h_f$$

$$v_f = \sqrt{2 a_y h_i}$$

$$= \sqrt{2 (9.8 \text{ m/s}^2) (5 \text{ m})}$$

$$= 9.87 \text{ m/s}$$

$$b) \quad h_i = 10 \text{ m}$$

$$v_f = \sqrt{2 a_y h_i}$$

$$= \sqrt{2 (9.8 \text{ m/s}^2) (10 \text{ m})}$$

$$= 14 \text{ m/s}$$

$$c) \quad v_i = 2 \text{ m/s} \quad h_i = 10 \text{ m}$$

$$\frac{1}{2} v_i^2 + a_y h_i = \frac{1}{2} v_f^2 + a_y h_f$$

$$v_f = \sqrt{v_i^2 + 2 a_y h_i}$$

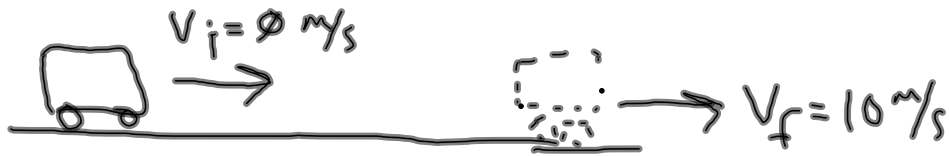
$$= 14.14 \text{ m/s}$$

Practice Problems 4.20.12 CP Physics

A 1500 kg car accelerates uniformly from rest to 10 m/s in 3 s.

a) What is the work done on the car in this time interval?

b) What is the power delivered by the engine in this time interval?



$$\begin{aligned} \text{a) } W &= \Delta E \\ &= (\cancel{K_f} - \cancel{K_i}) + (\cancel{U_{gf}} - \cancel{U_{gi}}) \quad \rightarrow \emptyset \\ &= \frac{1}{2} m v_f^2 \\ &= \frac{1}{2} (1500 \text{ kg})(10 \text{ m/s})^2 \\ &= 75000 \text{ J} \end{aligned}$$

$$\begin{aligned} \text{b) } P &= \frac{W}{t} \\ &= \frac{75000 \text{ J}}{3 \text{ s}} \\ &= 25000 \text{ W} = 33.5 \text{ hp} \end{aligned}$$